Diagnosis.	No. of cases.	Indican increased.	Indican diminished.	Indican normal.
Facial paralysis	2	0	0	2
Lead colic	2	2	0	0
Chron. arsen. poison	1	0	0	1
Ovarian tumors	3	0	0	3
Carcinoma uteri	3	3	0	0
Chronic ulcerations	5	5	0	0
Trichinosis	3	3	0	0
Hæmoglobin. paroxys.	1	1	0	0
Glanders with intestinal ulcers	1	1	0	0

OBSERVATIONS ON THE DIAGNOSIS OF DIPHTHERIA.

A STUDY OF ITS LOCAL TREATMENT AND A FEW CASES TREATED WITH ANTITOXIN.

By Francis H. Williams, M.D.,
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(Concluded from page 47.)

We now come to the clinical side of the local treatment of diphtheria, and the treatment to which I wish to direct your attention is that with strong hydrogen dioxide acid solutions.[1] The mortality in this State from diphtheria is greatest during October, November, December, and January, and my last service at the Boston City Hospital included the three latter months, November and December, 1893, and January, 1894, but I have permission to consider here the cases that were admitted in October, 1893, also.

On the mild, as well as on the hopeless cases, a 10-volume solution of hydrogen dioxide was generally used, alone or in connection with a solution of corrosive sublimate (1–5000 or 1–2500) or a solution of chlorinated soda. On *all* of the severer cases which came in the early days of the disease, and during my service, I endeavored to use a 50-volume hydrogen dioxide acid solution at short intervals.

To illustrate the advantages of using the 50-volume solution, let me take four patients who entered the hospital about the same time:

Two cases of diphtheria treated with a 10-volume solution of hydrogen dioxide.

P. H., aged twenty-one years, entered the hospital December 1st. Klebs-Loeffler bacilli found in the cultures. Thick false membrane on both tonsils and on the sides of the pharynx. Under treatment of 10-volume hydrogen dioxide solution every four hours the membrane had disappeared on December 20th, but there were still bacilli of diphtheria present on December 20th and 23d. The membrane returned again on January 1st. On January 3d no bacilli were found.

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[1] I have found these strong solutions useful in minor surgery; they should not be used in closed cavities, as too much oxygen might be set free and cause pressure.

As a dressing for sores and ulcers, one may use a 10-volume solution of hydrogen dioxide containing 0.1—0.2 per cent. of hydrochloric acid; when desirable pepsin may be added to this solution. The dioxide does not interfere with the action of the pepsin.

H. N., aged six years, entered the hospital on December 2d. Klebs-Loeffler bacilli found in the cultures. Small specks of false membrane on right tonsil and right palate. Ten-volume solution every three hours. Bacilli still present on December 25th; absent January 5th.

Two cases of diphtheria: the first one treated in part and the other wholly with a 50-volume solution of hydrogen dioxide.

S. M., aged ten years, entered the hospital on December 3d. Bacilli of diphtheria found in the cultures. This case seemed more severe than either of those above mentioned. False membrane on both tonsils, left palate, right anterior pillar, right and left wall of pharynx. At first a 10-volume solution was used, but as the membrane increased a 50-volume solution was substituted. Bacilli of diphtheria present December 10th; absent December 16th.

J. W., aged six years, entered the hospital December 8th. Bacilli of diphtheria found in cultures. A more severe case than any of the above. Thick false membranes on both tonsils and on both anterior pillars. The next day it covered the right, left, and posterior pharyngeal wall. The use of 50-volume hydrogen dioxide acid solution was then begun. Bacilli of diphtheria were present on December 11th, throat clear on December 16th, bacilli absent December 17th.

Of these four cases, the last two to enter the hospital presented more severe local symptoms than the first two, the last one, especially. The patients who entered the hospital December 1st and 2d, respectively, had a 10-volume hydrogen dioxide solution applied, and the bacilli were absent January 3d and 5th, respectively. Average duration of bacilli, thirty-four days. The patients who entered the hospital December 3d and 8th, respectively, had a 50-volume hydrogen dioxide acid solution, and the bacilli were absent December 16th and 17th, respectively. Average duration of bacilli, eleven days.

The three following cases further illustrate this point. The patients were adults of about the same age:

CASE I.—Membrane on tonsils and posterior pharynx. Cultures were made from the throat about every four days and bacilli of diphtheria found. On the fifty-third[1] day of the disease bacilli of diphtheria still found in the cultures; on the fifty-sixth day none was found. The treatment in this case was 10-volume hydrogen dioxide solution every hour, corrosive sublimate 1:2500 on a swab every two hours. Finally some of the strong hydrogen dioxide solution was used; after this had been applied for about three days the bacilli disappeared.

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[1] The duration of the bacilli in this case is above the average duration of the bacilli in the twenty-three cases alluded to later, in which the treatment was a 10-volume solution of hydrogen dioxide alone, or in connection with corrosive sublimate or chlorinated soda—but in two other of these cases the bacilli were present in the cultures three weeks longer than in this case.

One case of diphtheria in which a *partial* use of the strong dioxide acid solutions was made:

CASE II. entered the hospital more than two weeks later than Case I. Membrane on both tonsils. Klebs-Loeffler bacilli found in the cultures. As there was no strong dioxide solution at hand a 10-volume dioxide solution was used every two hours, followed by 1 : 2000 corrosive sublimate with 1 per cent. citric acid on swab. During the treatment the membrane spread and covered, besides both tonsils, the soft palate on both sides, anterior and posterior pillars, and the left and posterior wall of the pharynx. As soon as the strong dioxide arrived the above treatment was stopped and a 50-volume hydrogen dioxide solution was applied every two hours by day and every three hours by night for three days; then the intervals between the treatments were increased. After the culture made for diagnosis, no subsequent culture, unfortunately, was made until the twenty-sixth day of the disease. No bacilli were then found or afterward. This patient was discharged from the hospital two weeks earlier than Case I., and entered, as above stated, more than two weeks later.

One case of diphtheria, in which a *complete* use of the strong hydrogen dioxide acid solutions was made:

CASE III.—This case entered the hospital a month after Case I. Klebs-Loeffler bacilli found in the cultures. The membrane was everywhere, on tonsils, palate, uvula, pharynx, both sides and back, and in nose—a case which justified the old-fashioned term of putrid sore-throat. A 50-volume hydrogen dioxide solution was applied in spray every three hours during the day and twice during the night for five days; a 25-volume solution was then substituted which was applied three times during the day. No bacilli were present in a culture made on the eighth day of the disease nor at any subsequent examination. The throat of Case III. was free from bacilli two weeks earlier than Case I., although the patient entered the hospital a month later than Case I.

An estimate of the advantage in using the 50-volume solution, in point of the duration of the bacilli, is shown better by comparing the average time during which the bacilli remained in the throats of the milder cases which were treated with a 10-volume solution of hydrogen dioxide alone, or in connection with a solution of chlorinated soda or corrosive sublimate, with the average time during which the bacilli remained in the throats of patients more severely ill, but who, on the other, hand were treated with 50-volume hydrogen dioxide solutions. Most of both sets of cases occurred during about the same months.

In the first class of cases, twenty-three in number, the bacilli were found on the average to be present in the cultures on the twenty-seventh day of the disease and absent on the thirty-sixth day of the disease. No cultures were made between the two periods from which these averages were made up. The average age of these cases was seventeen years. In the second set of cases (severer ones), namely, those treated with strong hydrogen dioxide acid solutions, twenty-six in number,[1] the bacilli were found on the average to be present in the cultures on the twelfth day of the disease and absent on the 18.8 day of the disease. No cultures were made between the two periods from which these averages were made up. The average age of these cases was 19.4 years.[2]

It is hardly necessary to point out that the strong dioxide would probably have driven the bacilli from the throats of the milder cases sooner than it did from the severer ones.

In two-thirds of the twenty-six cases treated with strong hydrogen dioxide acid solution the *bacilli* disappeared *before* the *membrane;* in the remaining third this point was not determined. The patients were not discharged from the hospital until both bacilli and membrane had disappeared.

The capacity of a hospital for the treatment of diphtheria would be increased by using the local treatment with strong hydrogen dioxide solutions rather than those ordinarily employed, as the patients would remain in the diphtheria ward a shorter time.

The *diminution* of the bacilli in the throat under different treatments may be studied in some cases by examining a cover-glass preparation under the microscope made from swabs taken directly from the throat. This was done in a few cases only. After a patient had had, for example, a 10-volume hydrogen dioxide solution for ten days, bacilli of diphtheria and other organisms were readily found. In cases treated with 50-volume hydrogen dioxide solution examined in the same way from two to seven days after beginning treatment, very few organisms of any kind were found; bacilli were, however, found in the cultures in these cases for a longer period than in the cover-slips; these examinations show the marked and rapid diminution in the number of bacilli under the treatment by a 50-volume hydrogen dioxide solution.

The following case is one of those which illustrate how the 50-volume hydrogen dioxide acid solution may kill the diphtheria bacilli in a wound.

A patient ill with diphtheria had a contused wound, which was incised and the pus let out. A swab was taken from the wound, and the culture made from it was an almost pure culture of diphtheria bacilli. The flaps of thick dead skin were trimmed off, leaving an open wound about an inch in diameter covered with pus. The wound was cleansed with a

[1] These cases are twenty-six of the thirty cases formerly taken up; of the four remaining cases, two died and two had no bacterial test applied before discharge, therefore they could not be taken into consideration here.

[2] Since this was written I have used 0.5 per cent. salt-solution in eleven cases. In these the bacilli were found to be present on an average on the 26.3 day of the disease, and absent on an average on the 35.4 day of the disease. No cultures were made between the two periods from which these averages were made up. One of these eleven cases had what may be described as a raw-beef throat, a condition which lasted nearly as long as the bacilli remained in the throat, which was six weeks.

50-volume hydrogen dioxide acid solution on a mop and covered with gauze moistened with a 10-volume solution. Four hours later the gauze was removed, and a second swab taken; no diphtheria bacilli were found, only staphylococci. That the diphtheria bacilli were killed by the 50-volume hydrogen dioxide solution and the staphylococci were not, is in accord with the laboratory tests.

Since this paper was read I have used by the kindness of Dr. H. W. Cushing in certain patients in his service (surgical) the strong solutions of hydrogen dioxide, usually 25, sometimes 50 volumes, freely upon large granulating surfaces of burns and ulcers. When they were so situated that the strong dioxide solution could be poured into a cup-like depression of the granulating surface this was done, and the dioxide allowed to remain some minutes; it was then washed out and more strong dioxide solution poured in; this was repeated several times. The strong solutions should not touch the skin. The granulating surfaces were cleansed in this way daily for weeks without causing the patients any discomfort, and they were dressed with a dilute solution of hydrochloric acid ($\frac{1}{10}$ or $\frac{1}{5}$ per cent.). All healed well.

Let us now consider the method of applying the strong hydrogen dioxide solutions.[1]

THE STRENGTH OF THE APPLICATIONS. This depends upon what one wishes to accomplish, and should vary with the conditions which present themselves in the individual case; ordinarily from twenty-five to fifty volumes, according to circumstances, containing about $\frac{1}{10}$ to $\frac{1}{5}$ per cent. of acid, should be used. If there is much membrane, and especially if the case is septic and in the early days of the disease, the full 50-volume strength is needed. One should not omit to treat the nose and keep it clear, but a separate atomizer should be used for this purpose; in spraying the nose only very weak solutions, one or two to five volumes, should be used. The spray should be directed horizontally into the nostril and not upward. In the posterior nares the strong solutions may be employed by means of an up-spray; the formation of much foam after the application of the solution to the latter parts indicates the presence of membrane. The nose should not be blown strongly directly after spraying. It is very important to know the acidity and strength of the solutions of hydrogen dioxide, and the value of the treatment cannot be properly estimated unless analyses of the solutions are made. The different makes vary in the amount of acid and hydrogen dioxide they contain.

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[1] How not to use the solutions of hydrogen dioxide in diphtheria is very well illustrated, I think, by some cases that were brought to my attention since this paper was read. A solution of hydrogen dioxide in ether, known as pyrozone, was used to make the hydrogen dioxide solution. The manufacturers claim that these solutions are nearly neutral; in other words, an important germicidal element, the acid, is left out, the special property of the hydrogen dioxide itself being the disintegrating power. Second, the air-pressure used in the atomizers was too great. The air was pumped up to a pressure of eighty pounds, then allowed to run down to thirty pounds, and again pumped up to eighty pounds. The air-pressure should not be more than six or eight pounds.

The most efficient mode of application is by means of a gentle spray under an air-pressure of six to eight pounds—just sufficient to carry the solution to the desired spot; this avoids dilution better than when the applications are made on a mop, although sometimes a mop answers as well, and it is easier for the patient.

The discomfort of all local applications is usually greatest during the early days of the disease, when the throat is most sensitive and most congested, but at this time treatment is most serviceable. Later in the disease when the false membrane is clearing off, and if a sensitive, raw, congested surface is exposed, especial care should be taken to avoid these sensitive areas or to use the dioxide solution on a mop. One should be careful not to cause bleeding. The applications, especially in spray, should be made most gently. If the mop is used, the solution causes much less, sometimes no discomfort. The amount of discomfort is, in some instances, an indication of the want of skill in making the applications. While the smart of the strong dioxide is usually greater at the time than that of some of the other applications which are made to the throat, it is only momentary; patients invariably prefer the strong hydrogen dioxide solutions to chlorinated soda solutions of efficient strength. I recall some patients who spoke of the pain the strong dioxide solution caused, and I therefore tried, without their knowledge, spraying their throats with water, and often they did not distinguish between the two. It is the friction of the spray which I think largely causes the discomfort, and some throats are more sensitive than others and some patients more nervous. The majority of patients do not mind the strong dioxide solutions; many ask to have them applied oftener, on account of the relief which follows their use. In an adult, where the nose was closed with false membrane and the tonsils so much swollen and covered with false membrane as to cause cyanosis, the throat was cleared in a few moments by the use of the strong hydrogen dioxide solutions, and the breathing was thus made perfectly easy, although a few moments before tracheotomy had been considered.[1]

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[1] That the 50-volume hydrogen dioxide solutions are harmless when properly, even if very frequently applied, is illustrated by the following case, although before outlining it I should say that I do not consider it justifiable to use any local treatment hourly through the night.

B. R., a girl fifteen years old, nursery maid in a family where two children had just died of diphtheria, was sent to the hospital, probably about the first day of the disease, the family being on the alert for any symptoms of diphtheria. Clinically, the appearances in her throat were those of diphtheria, the false membrane covering nearly the whole surface of both tonsils. Unfortunately, no culture was made from the throat when the patient entered the hospital, and the swab taken next morning, after the strong dioxide solution had been applied a number of times, gave no bacilli of diphtheria, only staphylococci and streptococci: and that taken four days later, only staphylococci. There was a trace of albumin in the urine. A new house officer began his service on the afternoon of this patient's arrival, and, through a misunder-

THE NUMBER OF APPLICATIONS.—The strong hydrogen dioxide solutions should be applied often during the first few days; by often I mean once every two hours by day, and twice during the night for the first night or two in severe cases. It will be found, after a few days, in some cases after two or three, that the diphtheria bacilli are much diminished in number or have even disappeared from the throat, although much false membrane may remain. Their disappearance can only be determined by cultures; false membrane in the throat is not a proof of the presence of the bacilli of diphtheria; it may be due to other organisms. No matter how much membrane there may be in the throat, we may be much relieved when the bacilli have disappeared from the cultures. When this has taken place local treatment should be omitted, except to give comfort to the patient by clearing the throat.

I am inclined to think that the persistence of the Klebs-Loeffler bacilli for more than a week or ten days, under the strong hydrogen dioxide treatment, is due usually to their being concealed in the folds of mucous membrane or in pockets which have been made by the inflammatory process, especially in the tonsils, and that the attention should be directed to the application of the solution to these hiding-places carefully and thoroughly.

I observed that in some cases of diphtheria the false membrane persisted under the use of the 50-volume hydrogen dioxide acid solution for some time after the Klebs-Loeffler bacilli had ceased to be present in the cultures; staphylococci were however present. This led me to study the action of the 50-volume solution upon the staphylococcus and to find that it would not kill this organism readily in the beaker. It will be seen in Table V. that a 100-volume hydrogen dioxide (1 per cent.) acid solution is required to kill the staphylococcus in five seconds. Further I found that chlorinated soda would kill it in the beaker quickly (ten seconds) and that clinically the false membrane that had persisted under the use of a 50-volume solution yielded (I have used this in a few cases only) under the alternate use of the 50-volume solution and a solution of chlorinated soda containing from 1–1000 to 1–500 available chlorine.

The local treatment of membranous throats may, therefore, be best carried on with the microscope and culture-tube in one hand and the remedies in the other. As soon as the bacilli of diphtheria have disappeared the strong dioxide should be omitted, except as a cleansing, deodor-

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standing, the 50-volume dioxide solution was applied every hour through the night, and until my visit in the morning (making about eighteen successive hourly applications), when I reduced the frequency of the applications to once in three hours by day, and directed that she should be waked once at night for an application. The patient did not make the slightest objection to the frequent treatment, and, so far as I could see, only good had resulted from it. The congestion was lessened and the false membrane covered very much less than its original area, and by afternoon—twenty-four hours after entrance—was nearly gone; traces of it were then seen for the last time. This was more rapid in its disappearance than in any other case I have seen.

izing,[1] or disintegrating agent. If we find that the organisms present are chiefly staphylococci, we may substitute chlorinated soda for the strong dioxide, or use them alternately—they should never be mixed nor used too near together, or we may use hydrogen dioxide and carbolic acid mixed together. The 50-volume dioxide does not kill the staphylococcus readily in the beaker; it will not therefore in the throat.

It follows from what has been just said that in treating pseudo-diphtheria where staphylococci are present we may use hydrogen dioxide solution as a disintegrating agent and chlorinated soda and carbolic acid as germicides.

The streptococcus pyogenes is quickly killed in the laboratory by very dilute hydrochloric acid; in the throat this should be combined with hydrogen dioxide.

In passing let me add a word of caution as to the use of alkalies in diphtheria. Many practitioners prescribe lime-water in diphtheria, and many are in the habit of prescribing some simple local application containing bicarbonate of soda, such as Dobell's solution, in a case of sore-throat. Such alkalies seem to me disadvantageous in diphtheria, as they favor the growth of the bacilli and the formation of their poison, and we should, therefore, be careful to avoid them in this disease or where there is a suspicion of the disease. It seems better to have the diseased parts bathed in acid—not alkaline—solutions.

The instruments which I have designed and found efficient for applying the hydrogen dioxide solutions are, first, three glass atomizers, which can be readily sterilized by boiling. One of these has a down-spray, the second a return-spray, and the third an up-spray. The latter (see Fig. 1) may be used to direct the spray to the side and upper portion of the pharnyx or to either tonsil without taking it out of the mouth, simply by turning it in the hand. A spray is best applied to the surface of the tonsils if directed at right-angles to it. This can easily be done with this atomizer, which I find indispensable. The rubber bulbs of these atomizers have two valves. I also use an atomizer with a straight spray. The atomizer for spraying the posterior nares from behind forward (return-spray) is made by bending the atomizer shown in Fig. 1 through ninety degrees one-half an inch from its tip.

The mop which I use for swabbing the throat consists of a small glass rod on which some absorbent cotton has been twisted. The rod is about eight inches long and one-eighth of an inch in diameter, and is bent at an angle of about forty-five degrees half an inch from the end, in order that the sides of the pharnyx may be more easily reached.

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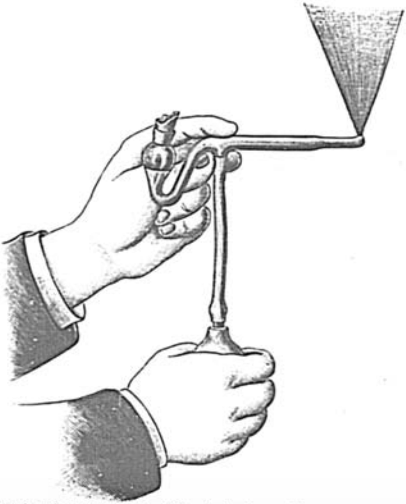
[1] A 5 per cent. solution of permanganate of potassium is frequently used as a deodorizer; a saturated solution contains about 6 per cent. of this substance; this would correspond as a source of oxygen to about a 6-volume solution of hydrogen dioxide.

The end of the rod is rounded and thickened a little by heating in a flame, as by this device the cotton is held more firmly.

To make the applications with success we should not only have good instruments but also the co-operation of the patient; it is a mistake to use force—I do not mean that young children should not be held in a position to let a good light fall into the throat, but the mouth should not be forced or pried open. One can nearly always gain the co-operation of children who are four or more years old (and I have used this treatment on children two years old who took it satisfactorily). If one begins tactfully, it is surprising to see how soon young children accept the habit of having the throat treated. It is not necessary to have the head lifted from the pillow. In order to accustom the patient to open the mouth properly I sometimes go through the manipulations of treatment once or twice with water instead of the remedy. It is very important to have the part which is to be treated well lighted, so that one may see exactly

FIG. 1.



From the thumb to the point the tube is five inches long. The up-spray is shown in this figure. The top-shaped bulb should not be filled more than one-half full. The mouth of the bulb may be loosely closed with a small roll of gauze (not absorbent cotton) to prevent spattering. (Made by McElroy, East Cambridge, Mass., U. S. A.)

what is *required* and also what is *done*. If the physician does not apply the treatment himself, he should see it done whenever he can. At night a very small kerosene lamp with a reflector, which also shades the eyes of the physician, a necessary condition to success, is good. I sometimes use a small electric light with a portable battery. It is not easy to apply local treatment properly in the throat, and the best results can only be obtained when great care is taken.[1]

In looking over what I have written it seems to me necessary to add some details essential to success in carrying out the treatment with strong hydrogen dioxide acid solutions, as there seems to be so much misconception about them as well as about the ordinary 10-volume solutions. Neutral solutions do not keep well and alkaline ones decompose readily. The hydrogen dioxide solutions which are sold in the market all contain some acid which increases their germicidal value and assists in preserving them.

The strong solutions of hydrogen dioxide may be made by evaporating the 10-volume solution (*U. S. Pharmacopœia*, 1890) in a porcelain dish over a stove or Bunsen burner; in this way one may, if one desires it, obtain a liquid containing 90 odd per cent. of hydrogen dioxide. A 50-volume solution (about 16 per cent.) of hydrogen dioxide may be readily obtained by evaporating a good 10-volume solution to one-sixth of its weight; a 25-volume solution by evaporating a good 10-volume solution to one-third of its weight.[2]

In making the strong solutions it is not necessary to add any acid, as but little of that present in the solution is lost, and 10-volume solutions containing 0.03 per cent. of acid when evaporated to one-sixth of their weight contain about 0.18 per cent. of acid, and this is as much as is required for use in diphtheria.

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[1] In the various inflammatory conditions of the throat, especially, for example, in measles and scarlet fever, it seems to me that there would be less tendency for the inflammation to extend along the Eustachian tube to the ears if pains were taken from the beginning to keep the throat and nose as clean as possible by means of solutions of hydrogen dioxide of suitable strength.

[2] If there were no loss of hydrogen dioxide during the evaporation, this process would yield a 60-volume solution, but about 20 per cent. of the dioxide is lost; therefore, in making a 50-volume solution it is necessary to evaporate a 10-volume to one-sixth instead of one-fifth of its weight. In making solutions of greater strength, the loss would be rather more; in making those of weaker strength, say 25 volumes, the loss would be less than 20 per cent. There is no economy in buying a solution that has not been well made, as it does not keep well and loses more on evaporation than a good one. The time required to evaporate 190 grammes of a 10-volume solution (*U. S. P.*, 1890) to 32 grammes (an ounce) of 50-volume solution is half an hour. One may carry on the evaporation at a gentle boil at the rate of about 6 grammes (one drachm and one-half) per minute.

For commercial purposes the strong solution can doubtless be made with a smaller amount of loss. I simply suggest how, in the emergency of diphtheria, one may quickly obtain a strong solution. Usually I make some ounces at one time.

In the solution of the Oakland Chemical Company the free acid seems to be chiefly hydrochloric, and this is the acid which I now prefer; it is a better germicide than sulphuric acid, although not so good as nitric. Hydrogen dioxide solutions keep better in cool than in warm places; they decompose more rapidly in sunlight.

I have lately made twenty-six experiments, extending over periods of from four to twenty-six weeks, upon the keeping-qualities of hydrogen dioxide solutions of strengths varying from 10 to over 100 volumes, and these tests show that the strong hydrogen dioxide solutions of 25 and 50 volumes of good make are sufficiently stable to be perfectly practicable.

Let me remind you in passing that the gastric juice contains 0.2 per cent. of hydrochloric acid; as this amount does not injure the lining membrane of the stomach it could hardly injure the throat when applied for a short period only.

Hydrogen dioxide is a bleaching-agent, and should not be brought into contact with the hair or colored fabrics. One should avoid getting the strong solution on the skin, as it may after a few minutes whiten it and cause a pricking sensation. It is probable that it attacks the dead outer layer of the epidermis, and hence the white appearance. A minute portion of the solution may get into some small cavities of the skin, and the oxygen gas be there liberated, thus causing pressure on the endings of the sensitive nerves.

Bromide of potassium is of much service to adults during the first few nights, as they are very anxious when they find they have so severe a disease as diphtheria; children do not need it, as they go to sleep directly after treatment, or if asleep are frequently not fully awakened by the treatment.

In many cases of retraction much relief follows the inhalation of steam or calomel fumigations.

There should be abundant and dry air in the patient's room and abundant and direct sunlight. Sunlight is especially advantageous in a diphtheria-ward on account of its excellent germicidal properties, and every room in a hospital for such patients should have this. The simplest construction will permit these conditions to be fulfilled. The building should run north and south, so that every bed may have sunshine part of the day. Overcrowding is extremely harmful.

The utmost attention should be paid to the nourishment of the patient; if too little food is taken by the mouth, it should be supplemented by feeding in other ways, as by the rectum or by means of a soft catheter and a funnel. The catheter may be inserted gently through the nose into the œsophagus and liquid food may be poured into the funnel.

Good food, absolute rest, protection from draught or from a temperature that might give the patient a cold, are to be insisted upon. In some cases stimulation is necessary. Strychnine, digitalis, and iron should be used when required.

The mortality from diphtheria differs in different cities (in recent years it has been very much higher in Boston than in some other cities) and in different institutions, and may differ in the same institution during the same period of time; these variations, I believe, *usually* depend not so much upon the special medical treatment employed as upon the state in which patients are admitted and the conditions which surround them after admission; by this I mean the ventilation of the ward, the amount of sunlight, the care taken in regard to the cleanliness of the instruments, exposure to other diseases, etc. The milder cases recover if no harmful treatment is employed.

At the Boston City Hospital there are two buildings for the scarlet fever patients, one belonging to the hospital, which is used for acute cases of scarlet fever, and the other, a wooden building, placed at the disposal of the hospital less than a year ago, which is used for the convalescent cases of scarlet fever. Diphtheria has developed in both buildings, but in the first the cases have usually been mild in character; in the second, the building for convalescents, they have been severe, among the most severe and fatal we have had at the hospital. The two buildings are erected on land that is only a few feet above high-water mark, but in the building that does not belong to the hospital the damp ground is not covered with cement, as is the case in the other building.

I have used the strong hydrogen dioxide acid solutions in over one hundred cases, which varied in age from two to sixty-eight years; some were cases of pseudo-diphtheria, and others were hopeless cases of diphtheria, in which it was used to give comfort to the patient by getting out membrane from the throat, so that swallowing was made easier, or to keep down the septic odor; again, others were cases that came under treatment early in the disease.

The 50-volume solutions fulfil the conditions sought; they will kill the bacilli of diphtheria in the laboratory in five seconds, and are not poisonous; they are readily decomposed into oxygen and water; they prevent the septic odor and take off certain portions of the false membrane better than anything else I have employed; under their use the congestion and glandular tenderness and enlargement are more quickly diminished, and the bacilli remain for a shorter time in the throat. Not only is the course of the disease shortened, but also the convalescence is conspicuously rapid compared with the cases under my care before I used this treatment. The patient is thus for a shorter time a menace to those around him, and the danger of the spread of the disease is much lessened. There is conspicuously less tendency to cardiac weakness.

In studying the effect of any local treatment upon the mortality, it seems to me that we should consider chiefly the cases in which the treatment has not been delayed too long—say, not beyond three days.

I will, therefore, discuss here two series of cases of membranous throats, occurring in different years, that were treated with strong hydrogen dioxide solutions, and comply with this condition. There were eighteen in the first series and thirty in the second series—forty-eight in all. During the first period there were, in all, twenty-three cases of membranous throats, the diagnosis of which was not based on cultures that entered the hospital within the first three days of the disease, so far as known. Five of these do not concern us, as they were not treated with strong solutions of hydrogen dioxide, but, being operative cases, were transferred directly from the medical to the surgical side of the hospital, were there intubed, and died two days after entrance. The remaining eighteen make up the first series of cases treated with strong hydrogen dioxide acid solutions within the first three days of the disease. One of these eighteen cases died; this was a laryngeal case at entrance.

During the second period there were, in all, forty cases of diphtheria, the diagnosis of which was based on cultures, that came under my care within the first three days of the disease. Ten of these cases do not concern us, for the following reasons: Seven were mild or very mild cases that recovered and were not treated with strong hydrogen dioxide acid solutions. The eighth was a child who entered the hospital on the *second* day of the disease, but on account of extreme homesickness did not have any treatment until the *fourth* day of the disease. She was then treated with the strong hydrogen dioxide acid solutions, and recovered. The ninth and tenth cases were not treated with the strong hydrogen dioxide solutions until after three days, as there was none in the ward for a time, or it was deficient in strength. These two cases died. The remaining thirty cases of diphtheria, making up the second series of cases under discussion, were treated with strong hydrogen dioxide acid solutions within the first three days of the disease, so far as known. Four-fifths of these thirty cases entered the hospital during the months in which the mortality from diphtheria in Massachusetts is greatest. Of these thirty cases two died. One was a woman, twenty-four years of age, who was vaccinated a few days before the attack of diphtheria began, and the solution used in this case was found to have been far below 50 volumes in strength. (In private practice I always test the solutions before using them.) The patient, some years before, had lost a brother and sister with diphtheria. The other was a child, four years of age, who took the treatment well for one day, but became delirious the next day, so that further treatment was impracticable, and died the following day.

It gives me pleasure to testify here to the careful manner in which the house officers and nurses carried out my instructions in regard to these patients.

I have used the strong hydrogen dioxide acid solutions at the Boston City Hospitals during the years 1892, '93, and January, 1894, six months in all, as well as in private practice, and have used them with increasing satisfaction.

In closing this paper, I wish to emphasize the importance of the early diagnosis of diphtheria, and, if the treatment be local, of prompt, gentle, and thorough treatment during the early days of the disease with strong hydrogen dioxide solutions of known strength, containing a proper amount of acid, applied with efficient instruments.

EIGHTEEN CASES OF DIPHTHERIA TREATED WITH ANTITOXIN.

Since this paper was read I have used antitoxin (Behring's and Aronson's) in eighteen cases of diphtheria. Four of these cases were mild, and recovered; seven were neither mild nor severe, and recovered; in these cases the antitoxin was given in the early stages of the disease; four were severe; three of these recovered and one died; in this case the antitoxin was given about the fifth day of the disease; three were hopeless cases when the antitoxin was given; these died. Excluding the four cases that died and the four mild cases there remain ten cases; four of these had paralysis, four some form of eruption like measles or urticaria, three suffered from pain in the bones, and two with swelling of the joints. The two latter cases I will outline briefly:

A. B., aged twenty-five years. As this patient had a child ill with diphtheria, I gave her 1 c.cm. of Aronson's solution as a preventive, but this did not prevent. Six days later she complained of a sore-throat; on the following day there were much congestion and swelling of the tonsils and pharynx, and there was a patch of false membrane on the right tonsil and posterior wall of pharynx. Temperature 102°. A culture made from the throat showed the presence of diphtheria bacilli. I injected 10 c.cm. of Behring's solution No. 2. On the day thereafter the false membrane had spread to the left tonsil, but within three days the throat was nearly clear and the congestion almost gone. On the seventh day of the disease no bacilli were found in the culture. The patient did remarkably well until the twelfth day, when she complained of pain in the left shoulder, back, and left leg; on the thirteenth day the pain was in the left shoulder, right wrist, and occasionally in the back. Hemorrhagic spots one-quarter of an inch in diameter and surrounded by a swollen area half an inch wide appeared, two on the palmar surface of the right hand and one on the palmar surface over the first phalanx of the third finger of the left hand, and one on each heel. These were very tender to the touch. The temperature had been normal for several days, but on this day there was a rise of temperature to 102° both morning and evening. On the fourteenth day the pain disappeared except from the finger. On the fifteenth day intense pain came on suddenly in the left arm, and for several days thereafter the pain returned suddenly during the afternoon and evening. From one-half to one grain of morphine was needed to relieve it. The extremities of the ulnar were swollen and the parts were hot and tender. Salicylate of soda, ten grains hourly, gave no relief, although physiological symptoms were soon produced. Iodide of potassium seemed for a few days to give some relief; there were less tenderness and swelling. The arm and hand were covered with cotton, and were kept on a splint extending from the elbow to the finger-tips. About the twentieth day of the disease the wrist and hand were much swollen and very painful; hot poultices gave more relief than anything else that was used locally. The pain was, as a rule, not severe during the day, but during the afternoon or at night morphine was required for about three weeks. Five weeks after the attack of diphtheria began the patient was more comfortable, although there was still some pain.

T. H., aged five years. Seen once in consultation with Dr. C. D. Sawin, of Charlestown. Dr. Sawin had given the patient 25 c.cm. of the New York solution of antitoxin before I saw him. I injected 10 c.cm. of Behring's solution No. 2, and subsequently Dr. Sawin gave 20 c.cm. more of the New York solution; the total amount of antitoxin given being 55 c.cm. On the ninth day of the disease there was a well-marked rash, followed on the eleventh day by urticaria with intense itching and great restlessness. On the fifteenth and sixteenth days the rash reappeared with swelling of the phalangeal joints and left elbow; also the right great toe, with inability to move any of the parts without considerable pain and discomfort; on the nineteenth day the patient was able to move the hands readily, but there was some difficulty in moving the left leg, while the right leg was almost useless, rash gone.

The rapid loosening of the false membrane may be a source of danger, as the following cases illustrate:

T. M., aged five years, well developed and in excellent condition. Bacilli of diphtheria were found in culture. I injected 10 c.cm. of Behring's No. 2 solution subcutaneously into the thigh. All other treatment was omitted. In the afternoon thereafter the patient was rather sleepy. On the morning of the third day, that is, twenty-four hours after the injection of the antitoxin, the patient's general condition had improved; in the afternoon the area of false membrane was smaller, and it was loosening and coming off. I took away with the forceps a piece of false membrane, one-half by three-quarters of an inch, which was hanging by a thread in front of the uvula, as I feared that it might be drawn into the trachea and choke the child. Twelve ounces of milk and two eggs were taken on this day. The urine was small in amount, and passed only an ounce at a time. Two loose dejections in the afternoon. The general and local improvement during these twenty-four hours was marked, and more rapid than usual in patients in her condition. On the fourth day the patient ate and slept well. There was less false membrane; a little remained on the right anterior pillar, and there was a small spot about an eighth of an inch in diameter on the left tonsil. Less congestion and swelling. On the fifth day the throat was nearly clear of membrane; only a small area remained on the right tonsil. Patient in excellent condition. I did not see her again, as my service was at an end; but by Dr. Withington's permission I give a further record of the case. On the eighth day the throat was clear of false membrane, and she was doing well. On the ninth day a rash of scarlet fever appeared on her chest, and spread all over the body. She vomited several times. On the eleventh day the respirations were from 50 to 60 a minute; but careful examination of the lungs and heart did not reveal anything else abnormal. On the fourteenth day there were bacilli still in the throat. On the seventeenth day the bacilli were absent. She stopped desquamating on the thirty-eighth day of the scarlet fever. Internal strabismus of the left eye was noticed about the fiftieth day of her illness. This disappeared in about two weeks.

S. E., a well-developed child, aged four and one-half years, whom I saw in consultation with Dr. H. W. Broughton, of Jamaica Plain.

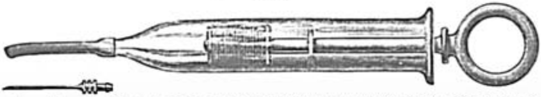
When I first saw her the temperature was 102°, pulse 120. The local symptoms were severe; there were much congestion and swelling; both tonsils, the uvula, both sides and the posterior wall of the pharynx were covered with a thick, false membrane, and there were complete aphonia and croupy breathing. I injected 15 c.cm. of Behring's solution of antitoxin, No. 3 (the strongest)—5 c.cm. in each of three places on the outside of the thigh. On the third day of the disease, twenty-four hours after the injection of the antitoxin, the false membrane had begun to loosen and looked moister. During the day the throat was sprayed twice with a 25-volume solution of hydrogen dioxide, which assisted in removing the false membrane from the pharynx. The improvement by the afternoon of this day was unquestionable; barring accidents the patient seemed likely to recover, although thirty-six hours before her recovery seemed doubtful. At 9.15 P.M. of this same day Dr. Broughton sent for me again, as the child had difficulty in breathing, and there was marked retraction. It seemed as if tracheotomy might become necessary directly. Dr. Broughton gave the child a teaspoonful of ipecac as an emetic, and three or four minutes later she got up a piece of false membrane one-quarter by one inch and a half long, and the breathing improved immediately. Abont half an hour later a small amount of mucus was vomited. Evidently the false membrane was separating in the larynx as it had done in the pharynx. It seemed to me now that tracheotomy might be avoided. This early loosening of the false membrane in the pharynx (as seen in T. M.), by which this membrane may get into the windpipe and choke the patient, and the rapid loosening of the false membrane in the trachea, is a danger about which one must be on one's guard in using antitoxin. Dr. Broughton remained at hand during the night, and every preparation was made for tracheotomy in case it should become necessary; but fortunately it did not. On the third day the temperature was normal, pulse 104, respiration 24. The patient took nourishment well, but spoke in a hoarse whisper. Pharynx almost clear of false membrane. On the tenth day she is reported as doing well, except that she has a whispering voice; up and dressed. Recovered.

The marked and rapid improvement, both local and general, and the very favorable statistics thus far of large numbers of cases of diphtheria that have been treated early in the disease, show that antitoxin is a remarkable remedy, and ways will probably be found to overcome some of the untoward effects that have followed its use. In many severe cases that come under treatment late in the disease, antitoxin does not seem to be of much service, but the reputation of this remedy will incline people to be treated earlier, and this will lower the mortality in this disease. In laryngeal diphtheria antitoxin is our chief reliance.

The syringe (see Fig. 2) which I have designed and use to inject antitoxin is a modification of the one I published in 1892; it is made of glass, and is packed with asbestos, and is joined to the hypodermatic needle by a short piece of rubber-tubing; by this device the antitoxin may be injected with greater ease into a struggling child, and the danger of breaking off the needle under the skin, an accident which may happen when the needle is rigidly fixed to the syringe, is avoided. This instrument may be sterilized by boiling in water.

In Europe local treatment is recommended to be used with antitoxin. In some of my patients I have used antitoxin alone, and in others I have combined with it local treatment with a 25-volume acid solution of hydrogen dioxide in the throat; and in nasal diphtheria I have used in the nose a dilute (2-volume) solution. These solutions may be used every three hours in spray. The loosening and softening action of the antitoxin, together with the disintegrating action of the hydrogen dioxide solution, removes the membrane rapidly, and the hydrogen dioxide solution lessens, if it does not obviate, the danger of pieces of false membrane getting into the trachea from the pharynx.

FIG. 2.



The cut is one-half the actual size. To use the syringe remove the needle, insert the rubber tube into the bottle of serum, and fill half to two-thirds full; put on the needle; next hold the syringe horizontally, and fill the needle with serum; insert the needle under the skin, and inject the serum, holding the handle up; the bubble of air near the piston allows all the serum in the syringe to be injected. When the syringe is made with a square instead of a pointed end this precaution is not required.

In treating diphtheria I now usually inject antitoxin and use a spray of hydrogen dioxide of appropriate strength locally in the throat, and a 2-volume solution in the nose once in three or four hours by day.

A CASE OF ACROMEGALY IN A GIANTESS.

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ABOUT the middle of February, 1893, "Lady Aama," a French giantess, was brought to this city to be exhibited in a "museum." A week or so later she was taken ill, and on the 27th of the month her death was reported.

Negotiations were opened with the party under whose escort she was travelling, and her body was secured for the museum of the State University at Iowa City, and an opportunity was thereby afforded me for examining what proved to be a most interesting anomaly.

Owing, however, to the unavoidable pressure of other work at the time of the autopsy and previous to the use of the body in the dissecting-room, I was unable to work out many of the details at all as thoroughly as I should have liked or as the importance of the subject deserved, and my only excuse for presenting such an imperfect sketch as follows is the great interest and unusual nature of the case.

For the careful measurement of the skeleton and the photographs, I am indebted to the kindness of Dr. J. W. Harriman and Mr. Frank Carroll.

"Lady Aama" had been reported and advertised to be "over eight feet" in height, but this was, of course, recognized as merely the "regulation stature" of all giants thought worthy of an introduction to the public, and it was no surprise to find that her height, or, more properly, length, when carefully measured five days after death, was exactly 6 feet 7¾ inches, though possibly it might have exceeded this slightly during life when the arch of the instep would be better supported and the intervertebral disks unshrunken. The measurements were taken between two uprights standing perpendicular to the table on which the body lay and pressed against the vertex of the head and heel and ball of the foot respectively.

Her baptismal name was Emma Alline Batallaid, and her birthplace on the slopes of the Jura in France, her age being variously stated by her sisters at nineteen and seventeen years, the latter appearing most probable on later examination as scarcely a third of the epiphyses in her skeleton were united with their apophyses, although this may have been a part of the general imperfect development of all her tissues. The "oldest" epiphysis united was that of the lower end at the tibia—eighteenth year (Quain).

The cause of her death was given as "quick consumption" which had lasted for only six months or so, but on more careful inquiry it was found that she had been failing gradually in strength for some four or five years past, and had died quite suddenly. She was exhibited within three days of her death from what appeared to have been an attack of la grippe or of acute bronchitis; death occurring from syncope after a severe fit of coughing. She suffered very little pain during her illness, but the muscular weakness was so extreme that for weeks before her death she was obliged to support herself when standing by holding on to an upright rod fixed in the floor. In fact, her death appeared mainly due to a general state of collapse hastened by an acute coryza.

She was the fifteenth child of a poor laborer, all the others being of normal height (one sister accompanying her and shown in Fig. 1). The latter declared that she was still increasing in height up to the time of her death.

Her intelligence was decidedly poor, but in no way abnormal.

The body was extremely emaciated, and the first thing which arrested the attention was the apparently small size of the chest and trunk as a whole compared with the greatly elongated extremities; this, of course, was merely in accordance with what I believe is the rule in such cases, viz., that the increase in height in giants and the decrease in dwarfs is principally in the limbs, the body being comparatively near the normal standard in both cases.

This impression was found to be correct by the measurements which revealed that the length of the lower extremity from the top of the great trochanter to the lower border of the os calcis was 47 inches, or nearly 60 per cent. of the total height, while the mid-point of the latter usually lies about an inch below this level, upper border of symphysis. (Quain.) According to Blanc's canon (*Artistic Anatomy*, Duval) as

2. The hypertrophy of the pituitary body and enormous size of the pituitary fossa.

3. The history of mental deficiency and long-standing progressive failure of strength, ending at last in death by syncope.

The enlargement of the pituitary body would appear to be the principal pathological characteristic of this disease, as it has been found to be present in ten out of the twelve cases, hitherto reported, in which autopsies were held. Its probable size in this case would appear to conform pretty closely to the average hypertrophy as reported, which ranges from one inch to one and one-quarter inches in antero-posterior and one and one-fifth inches to one and two-thirds inches in transverse diameter, the diameters of the pituitary fossa here being one and one-fourth and one and one-half inches respectively.

Of course, the interesting question suggests itself at once: What connection, if any, exists between the acromegaly and the giantism? and although the facts at our disposal are so few that any speculation upon the subject must be purely tentative, yet one is tempted to string them together upon some sort of a theory.

In the first place, it is interesting to note that giantism so far as accurately recorded would appear to be actually mainly an "acromegaly" extending to the whole extremity (both upper and lower) instead of merely confined to the last segment, the lower limb contributing such a large proportion of the excess of height. An approach to this condition even is recorded in some of the cases of acromegaly occurring in adult life in which not only the hand but the forearm and leg were enlarged (Pel, Dercum, Long).

Arnold[1] reports a case where the shoulder-girdle was thickened, and Berkley[2] one where the clavicles were enlarged. Dercum[3] records another where forearms, legs, and chest were greatly enlarged. The scapula and pelvis were enlarged in Osborne's[4] case. The forearms, patellæ, and clavicles in Pel's[5] case, and the forearm and leg in Long's.[6] The bones of the leg were thickened in Pechardre's case.[7]

In the four instances above, where the weight was given, the average was 215½ pounds.

Then, again, the picture of the giant given almost unanimously by secular (non-romantic) literature is that of a loose-jointed, weak-minded, stoop-shouldered sort of a being, with splay feet, huge hands, and projecting features.

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[1] Beitrage zur Pathologischen Anatomie, Band x., No. 1.

[2] Johns Hopkins Hospital Bulletin, September, 1892.

[3] AMERICAN JOURNAL OF THE MEDICAL SCIENCES, March, 1893.

[4] Ibid., June, 1892.

[5] Berliner klin. Wochenschrift, 1891, No. 3.

[6] Lehigh Valley Medical Magazine, 1891, No. 3.

[7] Revue de Méd., February, 1890.